EFFECT OF NICOTINE ON PULMONARY DEFENCE SYSTEMS.

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To protect itself against inhaled noxious agents the respiratory tract employs a vital defence system containing several organelles: the mucociliary system adsorbs and removes inhaled materials; sensory neuroreceptors control respiration: shallow breathing impedes penetration of agents into deeper lung zones, coughing removes particle-laden mucus; bronchial smooth muscle, by causing bronchoconstriction, may limit the depth of particle penetration and will increase the linear velocity of air, thereby improving cough efficiency. Mucosal blood vessels with their dense innervation determine mucosal thickness and mucosal liquid flow, they also import inflammatory cells and mediators into mucosal tissues, initiating restitutive processes following mucosal damage.

Nicotine given acutely affects a number of these systems. Nicotine increases mucus secretion both after local application and after systemic uptake. Local effects are observed at high concentrations of nicotine reached during the smoking process. Local effects appear to be mediated by nicotinic receptors in the end organ or by neural pathways not involving sodium channels nor release of endogenous neuropeptides. There are added secretory effects of systemic nicotine which are mediated through muscarinic receptors. These secretory effects of nicotine are complemented by irritant effects on sensory receptors causing cough. Nicotine further promotes particle clearance by increasing the beat frequency of respiratory tract cilia, an effect which is independent of the increase in mucus secretion. Nicotine increases airway smooth muscle tension through cholinergic neural pathways and through muscarinic receptors in the end organ. There is evidence that part of the effect is caused by axon reflexes following irritation of sensory C-fibres with release of neuropeptides which is in contrast to effects of nicotine on airway secretion where endogenous neuropeptides play a minor role if any. Nicotine by itself (given locally) can increase blood vessel diameter and permeability by its effect on peptide-containing nerves but these effects are opposed by systemic nicotine causing powerful vasoconstriction through the release of catecholamines from sympathetic nerve endings and from the adrenal medulla. Summarizing, mucus secretion, cough, bronchoconstriction and increased ciliary beating are likely to improve mucociliary clearance whereas the balance of vascular effects is difficult to predict. Vasodilation would augment, vasoconstriction inhibit mucosal oedema and inflammation.

Chronic effects of nicotine on submucosal glands include a significant shift from serous to mucous acini, in some cases outright gland hypertrophy. This shift in gland structure is analogous to the shift seen in chronic bronchitis or after chronic β-adrenergic stimulation and is undesirable because it may contribute to the chronic hypersecretory state seen in (and adding to) obstructive disease. Thus, although many short term effects of nicotine aid mucociliary clearance long term application is likely to impede clearance mechanisms by causing obstruction and by adding to the mucus load the system has to cope with.